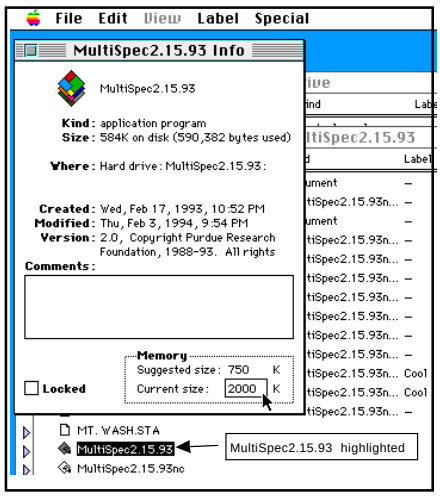
- Click on the **Beverly,MA Disk** icon and drag it to the **Trash** to **eject** the disk.
- It is important that the **.LAN** files and the **.STA** files be placed in the **MultiSpec folder** on the hard drive. The **.STA** files contain statistics for the display of the applicable images.

Memory Options

The MultiSpec programs you received have been preset to use 2 megabytes (2000K) of RAM. This is sufficient for 8 bit color. If you do not have at least 4 megabytes of RAM on your Macintosh computer or you would prefer not to address memory concerns at this time, **you may skip this section**.

If you wish to change the amount of RAM assigned to this program, you may proceed with the following steps.

- Be sure you have quit the MultiSpec program.
- If the **MultiSpec Folder** is not open, open it now by clicking on the arrow to the left of the words MultiSpec Folder on the hard drive. The arrow will point downward and reveal the contents of the folder. Highlight the **MultiSpec application program** on your hard drive by clicking ONCE on the icon identifying the program. DO NOT double-click on the application program icon or you will open the program at this time. You do not want the application program open for this procedure, just selected (highlighted).
- With the **MultiSpec** application program highlighted, pull down the **File** menu and select **Get Info.** You should see the following on your screen.



- In the **Memory** box, where the small arrow in the diagram points, edit the **Current size** box to read 4000 K.
- Close the **Get Info** window. You are now ready to run the program.

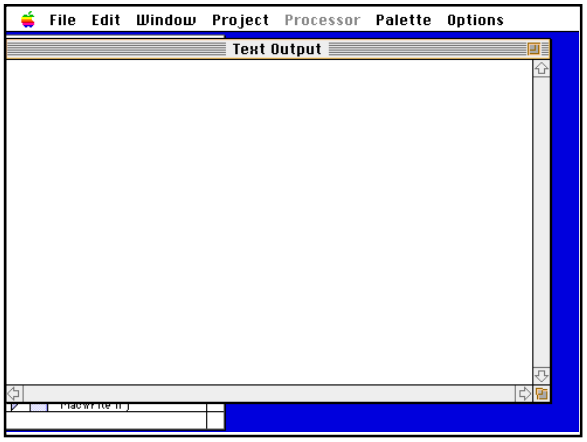
Investigating a satellite image

Materials needed:

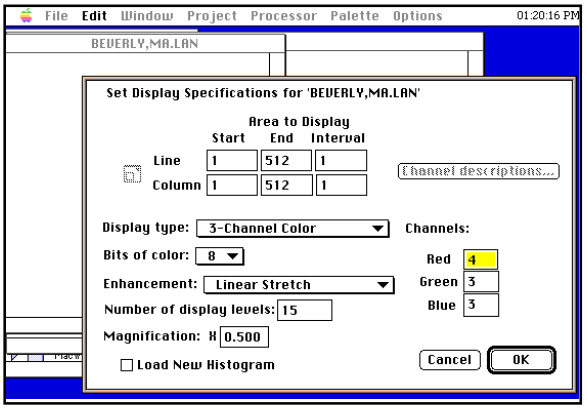
Macintosh computer with **BEVERLY,MA.LAN** image installed

Getting Started:

- After turning on your computer, open the hard drive by double clicking on the hard drive icon.
- Double click on the **MultiSpec folder** to open it.
- Double click on the **MultiSpecFatxx.xx.xx** (or **MultiSpecxx.xx.xxnc**) icon to start the MultiSpec program. The window labeled **Text Output** should appear. Your screen should be similar to the one shown in the diagram below.

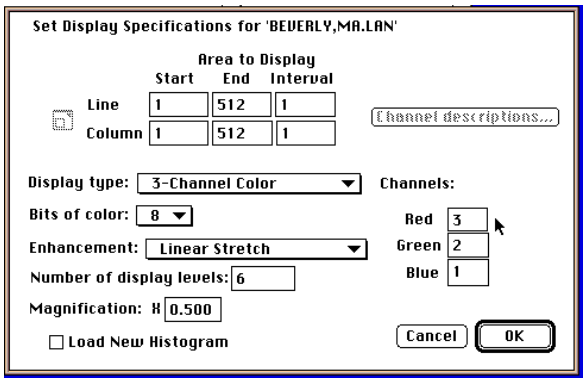


- Pull down the **File** menu and select **Open Image**. Double click on **BEVERLY,MA.LAN** to select that Landsat satellite image.
- You should now have a dialogue box entitled **Set Display Specifications for 'BEVERLY,MA.LAN'** displayed on your screen.

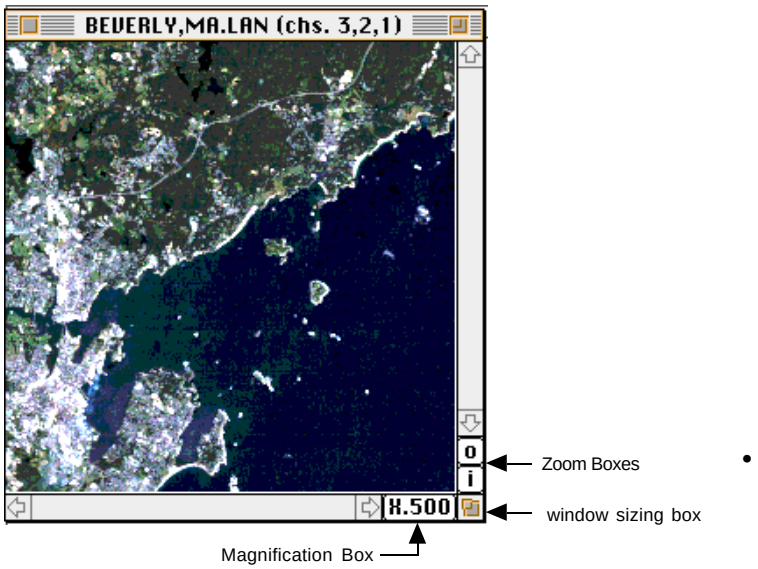


- Click on the box labeled **Display type** and be sure **3-Channel Color** is selected.
- **Leave 8 bits of color selected**! (If you have assigned more than the standard amount of RAM to this program and you have 24 bits of color available on your computer, you may do the following: Click on the Bits of color box and select **24**.) If you select 24 bit color when you do not have enough memory assigned, you will receive messages telling you "**not enough memory is available**" and your display image will have problems. This message is not referring to the amount of memory in the computer but to memory allocation.

- Under **Channels** set **Red** box to **3** , **Green** box to **2** , **Blue** box to **1** and click **OK**. NOTE: BACKSPACING OR DELETING THE OLD NUMBER FIRST IN THIS PROGRAM MAY NOT WORK. To edit the number appearing by each color, click to the left of the number and, without releasing the mouse button, drag the mouse to the right or double-click on the box. This should highlight the number you want to change. When it is highlighted, release the mouse button. The box should stay highlighted. Now type the number you wish to enter in the box. You may use the **tab** key to move between boxes on the screen.



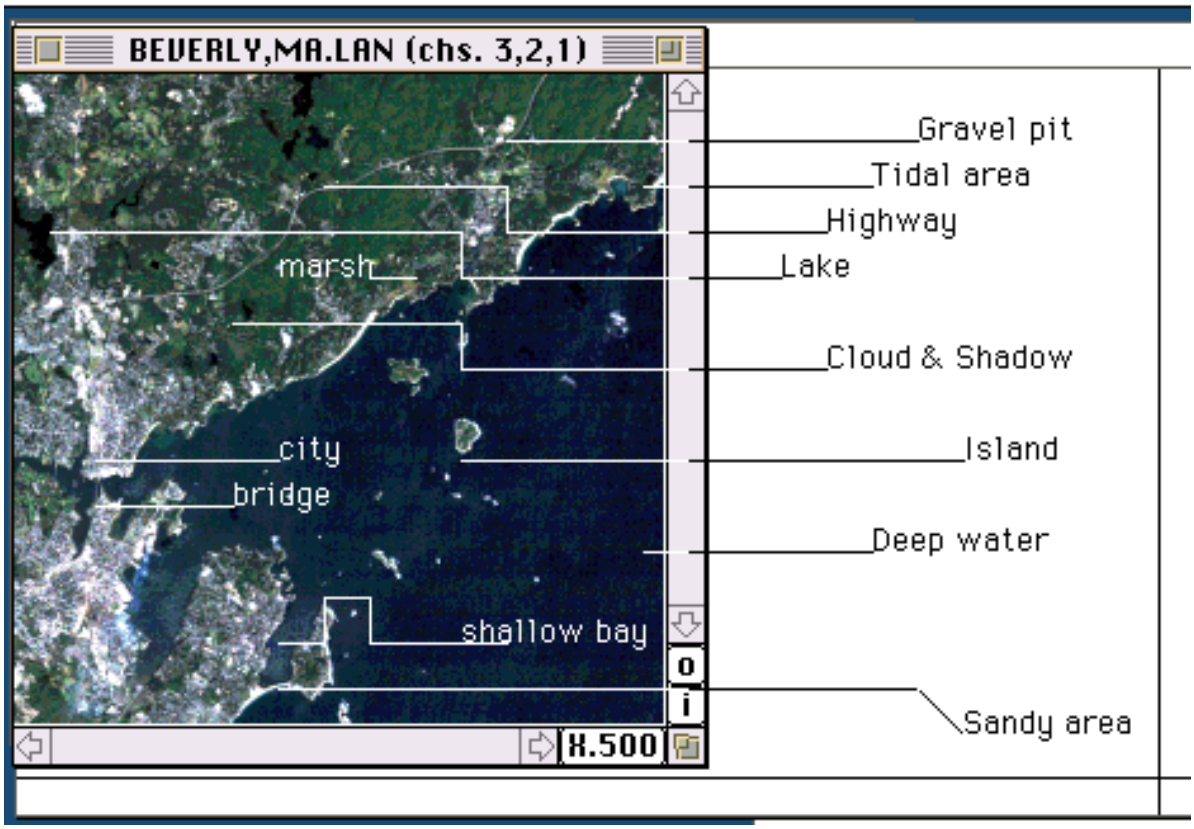
- Click **OK**. The image display should now appear in the upper left of your screen. At **X.500** magnification you can see the entire image at once.



- To enlarge the window, click in the window sizing box in the lower right corner of the image window and drag the box to the right and down. In the lower right hand corner of the image window, just to the left of the window sizing box is the magnification box that shows X.500.

Click on that box. The box should now read X1.0 and the image should enlarge and fill (or almost fill) the viewing window depending on how much you enlarged the image window. You have to scroll up or down to see the whole image when the magnification is X1.0 unless your monitor is 17-inches or larger.

1. Try to identify roads, bridges, lakes, towns, regions with trees, beaches, marshy regions near the shore, shallow ocean waters. What other features do you notice?



2. Zooming:

Notice that just above the window sizing box in the lower right hand corner there are two small boxes labeled **(i)** and **(o).** These are zoom boxes allowing you to zoom **i**n and **o**ut from the current image scale. Notice the magnification box **X1.0** in the lower right hand corner of the viewing window. Click the **i** once. Now click on **i** many, many times. You should eventually see the image appear as a mosaic of squares (pixels) on the screen. Observe the numbers appearing in the magnification box as you click on **i** or **o**. As you zoom in and out, this box gives zoom factors. **X1.0** means full size image. Before proceeding to #3, click on the magnification box. The image should now be full size and the magnification box should read **X1.0**.

Questions:

a. What do you notice about the length of objects when you zoom in? when you zoom out?

Objects increase/decrease in length proportionately with the zoom factor.

b. What information is gained when you zoom in or out? What information is lost?

When you zoom in, you can focus on a smaller region. Eventually the image becomes a mosaic of pixels. When you zoom out, you can see a larger region at once.

Click on the **magnification** box to return the display image to full size. The magnification box should read **X1.0**.

3. Zoom Box:

You also can zoom in on a specific region by boxing the region and zooming. Place the mouse pointer at the upper left corner of the area you wish to box. then click and hold the mouse button while moving the mouse to the right and down. When you have boxed off the desired area, release the mouse button, notice that the region you selected is delineated by dashed lines. Click on **zoom in (i)**. You can continue to zoom in on the selected region by continuing to click on **(i)**. What do you observe? If the zoom box is not square, do the image proportions appear to change? Give reasons for your answer.

The proportions of a figure do not change. Lengths all change proportionately. Shape stays the same, size changes.

To zoom in or out by tenths, hold down the **option** key while clicking on **zoom in (i)** or **zoom out (o)**.

Return to the full image by clicking on the magnification box so it reads **X1.0**.

4. Panning:

In order to move (pan) around the image, first hold the **option** key down and a hand icon will appear. Clicking and holding the mouse button down while moving the mouse will cause the image to move in conjunction with the mouse. As with all Macintosh applications, you can also use the scroll bars to pan.

(To exit the program at any time, under the **File** menu select **quit**. Close all remaining windows before selecting **Shut Down** under the **Special** menu.)

Investigating color in a satellite image

Image Display:

Under the **Processor** menu select **Display Image.**

Please read the following information about color and Landsat satellite images. The colors red, green, and blue refer to the computer monitor color guns. (They apply red, green and blue light to each pixel in specific intensities.) The **channels** (often called **bands**) refer to bands of reflected light sensed by the satellite from the objects in the image. Band 1 is reflected blue light, band 2 is reflected green light and band 3 is reflected red light. Red, green, and blue are the primary colors of visible energy. Different hues (shades) of color are obtained on the screen when color guns apply different intensities of red, green, and blue light to the same pixel. For example, equal intensities of red and green light produce

yellow; equal intensities of blue and green light produce cyan; and equal intensities of blue and red light produce magenta. Bands 4 and 5 receive reflected near infrared and mid infrared energy, respectively.

We will use the following red, green, and blue (RGB) channel settings in order to get a feel for different channel (band) combinations.

True color images - This band combination presents an image as it would appear to the human eye, looking back from space.

Red 3 (the visible red band)

Green 2 (the visible green band)

Blue 1 (the visible blue band)

Other band combinations result in images that do not appear as they would to the human eye. These images are called **false color images**. Enter the following band combinations and observe the results.

A. The band combination below mimics infrared aerial photographs. Plant material, which reflects a great deal of infrared energy, will stand out as bright red with this band combination. This is useful to people studying forests.

Red 4 (the near Infrared band)

Green 3 (the visible red band)

Blue 2 (the visible green band)

B. This band combination is especially good for separating trees and grassland. The conifer or evergreen trees appear as intense dark green, deciduous trees appear as medium green, and grassland appears as light green or yellowish green.

Red 5 (the mid Infrared band)

Green 4 (the near Infrared band)

Blue 2 (the visible green band)

Use the computer image of **BEVERLY,MA.LAN** for the following activity.

Locate the features in the chart on the next page using each of the Red, Green, Blue (RGB) channel settings listed. Record the color of each feature under each channel (band) combination. RGB 321 means assign Channel 3 to the red color gun, Channel 2 to the green color gun and Channel 1 to the blue color gun. TO CHANGE COLOR GUN ASSIGNMENTS PULL DOWN THE **PROCESSOR** MENU AND SELECT **DISPLAY IMAGE**.

Trouble shooting hints:

If, by mistake, you pull down the File menu and select open image, you will have to correct ALL settings, instead of just the color assignments. To do this, go back to the GETTING STARTED directions to be sure you do this correctly.

If you end up with a very tiny image it means you selected a small piece of the image by mistake and asked to have it displayed. Under the **Processor** menu select **Display Image**. Click on the small box in the upper left hand corner to the left of the words: **Line** and **Column**. This will return the image to the full 512 by 512 pixel display.

Complete the chart, recording the color of each feature under each channel (band) combination.

	RGB	**RGB**	**RGB**
	321	432	542

- Beaches
- Highways
- Regions with trees
- Ocean
- Cities or towns

Try other channel (or band) combinations and write your observations.

Reference Page

MultiSpec Bands and Their Uses

Band	Principal applications
1 Blue visible light	Useful for mapping water near coasts, mapping forest types, differentiating between soil and plants, and identifying human made objects such as roads and buildings (cultural features).
2 Green visible light	Useful for differentiating between types of plants, determining the health of plants, and identifying cultural features.
3 Red visible light	Useful in differentiating between plant species differentiation and identifying cultural features.
4 Near-Infrared energy	Useful for determining plant types and plant health and for seeing the boundaries bodies of water.
5 Mid-infrared energy	Useful for distinguishing snow from clouds and determining vegetation and soil moisture content.
6 Thermal- infrared energy	(Not included on Landsat Unit disks) Useful in determining relative temperature and determining the amount of soil moisture.
7 Mid-Infrared energy (longer wavelength than band 5)	(Not included on Landsat Unit disks) Useful for differentiating between mineral and rock types and telling how much moisture plants are retaining.

Reference: Lillesand, Thomas M. & Kiefer, Ralph W. (1987), *Remote Sensing and Image Interpretation*. 2nd Edition. New York: John Wiley and Sons. P. 567.